Interaction of diamond powder with the brain cancer cells

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Can Diamond and Noble Metals' Nanoparticles Affect Molecular Response of the Organism?

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Nanoparticles have unusual abilities to penetrate organism, force biological membranes and rich such unavailable molecules like DNA and RNA. The meeting between nanoparticles and DNA can occur in different ways, depending on kind, size and shape of nanoparticles. The interaction between nanoparticles and DNA can result in specific self-assembling, governing biological consequences of this meeting. Furthermore, nanoparticles can affect gene expression measured on RNA level.

We have performed experiments, evaluating morphology of the meeting between nanoparticles of diamond, silver, gold and platinum and expression of selected genes. Diamond nanoparticles were produced by the detonation method (Mitura et al., 2009), nanoparticles of Ag, Au were

produced by chemical methods (Grobelny et al., 2009) and Pt were produced by electric nonexplosive
method by Nano-Tech, Poland. Morphology of the self-assembling of nanoparticles and DNA was examined by TEM (JEOL model JEM-2000EX). The expression of fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF), paired box 7 (PAX7) factor and proliferating cell nuclear antigen (PCNA) was measuered in mRNA.
Morphology of bio-interaction of nanoparticles of diamond and DNA did not indicate harmful or modifying effects on DNA structure and affinity to DNA. Noble metals, especially silver have shown significant affinity to DNA and furthermore, structure of DNA was rearranged. Nanoparticles affected expression of FGF, VEGF, PAX7 and PCNA genes, but to different extent for particular genes.

Nanoparticles of Diamond do not Stimulate Angiogenesis in Chicken Embryo Model

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Diamond powders have extended surface of carbon layers, which can be applied as the implants material. Diamond Powder Particles (DPP) has anti-inflammatory, antioxidant and anticarcinogenic
properties. In this paper we used nanodiamond particles manufactured by detonation method.
The objective of experiments was to evaluate biocompatibility of diamond nanoparticles by examining morphological status of development and angiogenic response (chorioallantoic membrane - CAM assay) in experiment performed *in ovo*, on chicken embryos' model. Nanodiamond particles did not influenced homeostasis of embryos development according to Hamburger and Hamilton standards, including detailed morphological evaluation and weight of dissected organs. Nanoparticles of diamond did not stimulate angiogenesis, new vessels developing radially toward the implant were not observed, moreover, there was a tendency to reduce vasoproliferative process. Furthermore, affinity to penetrate inside vessels was noticed, and a part of nanoparticles was seen as a tin gray stream flowing with blood in vessels of embryos receiving 5000 ppm nanodiamond particles.

Interaction of Diamond Powder with the Brain Cancer Cells

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Cancers and metastasis, even intensely investigated, still remain extremely difficult in clinical treatment. Poor antitumour drugs solubility is one of the major obstacles in cancer therapy. Proper solvents are required for drugs to be absorbed by the cancer cells. However these substances not only impair drugs activity but also may possess toxic characteristics.
Diamond powder (DP) is characterized as biostabile, biotolerant material with the surface allowing for the connection with the biological active substances and also nano-size, what naturally autonavigates nanoparticles towards the cancer cells. Thanks to its biological features, DP may be employed as the modern carrier of the antitumor drugs. The first step in DP evaluation is the observation of the interactions between diamond and cancer cells.
The presented study was performed on human glioblastoma cell line (U87MG) using *in vitro* and *in ovo* models (chick embryo chorioallantoic membrane – CAM). Morphology of the cells treated with diamond (Mitura i wsp. 2009) was estimated by TEM (JEOL model JEM-2000EX). Mitochondria morphology was observed in confocal microscope (Olympus FV1000). The effect of DP on the tumour development and angiogenesis was also evaluated (stereoscope microscope Olympus SZX10).
We did not observe the impact of carbon on whole cancer cells and their mitochondria morphology. In the study group treated by DP we found significantly decreased number of blood vessels.